

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
LightSquared Request to Modify Its ATC)	IB Docket No. 12-340
Authorization)	
)	IBFS File Nos. SAT-MOD-20120928-
)	00160; SAT-MOD-20120928-00161;
)	SAT-MOD-20101118-00239; SES-MOD-
)	20121001-00872
)	
LightSquared Technical Working Group)	IB Docket No. 11-109
Report)	
)	DA 16-442

REPLY COMMENTS OF DEERE & COMPANY

Catherine Wang
Tim Bransford
Morgan, Lewis & Bockius LLP
2020 K Street, N.W.
Washington, DC 20006
Tel. (202) 373-6000
Fax (202) 373-6001
catherine.wang@morganlewis.com
timothy.bransford@morganlewis.com

Attorneys for Deere & Company

Dated: June 21, 2016

Executive Summary

Deere wishes to clarify for the record: (1) its position with respect to the grant of the Modification Application; (2) the appropriate terms and conditions of any such grant; (3) the proper characterization of the Deere-LightSquared litigation Settlement Agreement; and (4) the appropriate metric for determining whether a GPS receiver under test has experienced harmful interference. As a leading global manufacturer of state of the art agricultural and other industrial machinery, Deere has actively promoted expanded broadband deployment, particularly in rural areas where modern farming relies on high precision navigation and broadband services to support the smart farming techniques now prevalent in the Agricultural sector.

Deere's primary interest in Ligado's network proposals -- and in its predecessor's proposal -- is to ensure that the deployment of a terrestrial high power network in what was historically satellite spectrum will not cause interference to the adjacent U.S. GPS and other international Global Navigation Service Systems ("GNSS"). Deere herein confirms that it does not oppose grant of the Modification Application, as proposed, that would incorporate the full set of technical parameters and licensing conditions, including specified power limits, out-of-band emissions ("OOBE") limits, and the determination that the 1545-1555 MHz band may not be used for terrestrial operations, consistent with Deere's Settlement Agreement with Ligado. Deere cautions that the Settlement Agreement reflects Deere's judgment only that, notwithstanding interference to existing Deere receivers, it will be able to address interference issues in its technology plan for future Deere receivers assuming the Ligado network complies with the technical and other terms set forth in the Settlement Agreement. The Deere Settlement Agreement was not intended to be -- *nor could it be* -- a resolution of all technical and public

policy issues that may be raised by Ligado's Modification Application. Any other technical and public interest issues raised in this proceeding are outside the scope of Deere's Settlement Agreement and this Reply.

Finally, Deere cautions that its position with respect to Ligado's Modification Application must not be interpreted as Deere's acquiescence in or support for a metric *other than* the established 1 dB decrease in carrier-to-noise power density standard to determine potential harm to GPS and other GNSS systems. Deere remains a staunch supporter of the 1 dB C/N_0 standard for assessing interference. No empirical, universal, and quantifiable alternative to the 1 dB C/N_0 standard exists for evaluating harmful interference into GPS/GNSS service. Deere urges the Commission to avoid the obvious pitfalls and shortcomings of attempting to evaluate interference into GPS/GNSS service based on end user outputs or metrics, which are inherently subjective and unreliable in this context. GPS/GNSS stakeholders filing comments in response to the Commission's public notice, including both prominent GPS device manufacturers and end users, share this view and expressed unified and unwavering support for the 1 dB C/N_0 standard. The contrary view espoused by Roberson and Associates wrongly asserts that no correlation exists between a 1 dB decrease in C/N_0 and harmful interference. While the test report put forth as support for a different measurement method is conclusory and provides inadequate data for Deere to assess how devices under test reacted to a 1 dB decrease in C/N_0 , prior test efforts have already confirmed the correlation between such a decrease and harmful interference.

Deere remains committed to working with the Commission, the Department of Transportation, Ligado and other stakeholders to evaluate future proposals and solutions for supplemental terrestrial services in the L-band and elsewhere.

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REPLY COMMENTS OF DEERE & COMPANY

Deere & Company (“Deere”) hereby submits this Reply to the Public Notice¹ seeking comment on the application for modification (“Modification Application”) submitted by Ligado Networks LLC (“Ligado”) regarding its Mobile Satellite Service (“MSS”) licenses.² Deere wishes to clarify for the record: (1) its position with respect to the grant of the Modification Application; (2) the appropriate terms and conditions of any such grant; (3) the proper characterization of the Deere-LightSquared litigation Settlement Agreement and Mutual Release³

¹ See Comment Sought on Ligado’s Modification Applications, Public Notice, DA 16-442 (rel. Jun. 22, 2015) (“Public Notice”).

² Collectively, the “Modification Applications.” In these comments, we use the term “Ligado” to refer to New LightSquared and its subsidiary LightSquared Subsidiary LLC. For convenience when referring to earlier versions of its terrestrial network proposal, “Ligado” as used herein also refers to “LightSquared” and its subsidiary “LightSquared LLC.”

³ The Settlement Agreement and Mutual Release is on file with the Commission. See New LightSquared LLC Ex Parte Presentation, IB Docket Nos. 12-340, 11-109; IBFS File Nos. SAT-MOD-20101118-00239, SAT-MOD-20120928-00160, SAT-MOD-20120928-00161, SES-Mod-20121001-00872, SES-RWL-20110908-01047, SES-MOD-20141030-00835 (filed Dec. 8, 2015).

(“Settlement Agreement”); and (4) the appropriate metric for determining whether a GPS receiver under test has experienced harmful interference.

In the Public Notice, the Commission seeks comment on whether the proposed set of technical parameters for Ligado’s operations in the 1526-1536 MHz, 1627.5-1637.5 MHz, and 1646.5-1656.5 MHz bands, along with proposed license conditions, effectively resolve interference concerns related to the United States Global Positioning System (“GPS”) that previously have been identified in these proceedings as well as any other interference concerns.” In particular, the Commission seeks comment on the “significance to [the Commission’s] considerations of the agreements between Ligado and Deere, Garmin, and Trimble.”⁴ Furthermore, the Commission asks whether there remain any unresolved concerns of potential harmful interference to GPS receivers and devices should Ligado operate a terrestrial mobile network that reflects the technical parameters set forth in the GPS entity litigation settlement agreements.”⁵ The Commission specifically seeks information on the basis of any potential interference concerns that exist even if Ligado operates its network in compliance with the technical parameters outlined.

I. DEERE’S INTEREST AND THE IMPACT OF INTERFERENCE TO GPS ON PRECISION FARMING

At the outset, Deere reiterates that it is a strong supporter of expanded broadband services and has actively advocated for greater broadband deployment in rural areas to help meet the growing bandwidth demands of high precision farming that make up modern agricultural operations.⁶ Today’s agricultural equipment incorporates state-of-the art precision guidance

⁴ Public Notice at 7.

⁵ *Id.* at 8.

⁶ See Comments of Deere & Company, *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans In a Reasonable and Timely Fashion et al.*, GN Docket No. 15-191 (filed Sept. 15, 2015); Comments of Deere & Company, *Connect America Fund; A National*

systems and technology designed for intense data gathering and processing.⁷ GPS-enabled precision steering systems, modems, sensors, third-party and cloud applications, and powerful in-cab and farmhouse analytic and mapping programs comprise the highly specialized systems that are expected to enable today's farmers to meet the rising global demand for food in an increasingly challenging economic environment.⁸ These agricultural systems require both interference-free precision navigation systems and adequate rural broadband and wireless coverage to deliver the efficiency and performance gains that are necessary to feed the expanding world population.

Deere's primary interest in Ligado's network proposals -- and in its predecessor's proposal -- is to ensure that the deployment of a terrestrial high power network in what was historically satellite spectrum will not cause interference to the adjacent U.S. GPS and other international Global Navigation Service Systems ("GNSS"). Interference to the nation's GPS system would certainly affect the location technologies embedded throughout many sectors but the impact on the agricultural sector would have widespread and substantial ramifications that must not be underestimated. Agriculture and agriculture-related industries contributed \$835

Broadband Plan for Our Future; ETC Annual Reports and Certifications; Establishing Just and Reasonable Rates for Local Exchange Carriers; Universal Service Reform – Mobility Fund; Developing a Unified Intercarrier Compensation Regime, WC Docket Nos. 10-90, 07-135, 14-58; WT Docket No. 10-208; CC Docket No. 01-92 (filed Aug. 8, 2014); Reply Comments of Deere & Company, WC Docket Nos. 10-90, 07-135, 14-58; WT Docket No. 10-208; CC Docket No. 01-92 (filed Sept. 8, 2014); Comments of Deere & Company, *Broadband Opportunity Council Notice and Request for Comment*, Rural Utility Service, U.S. Department of Agriculture, and the National Telecommunications and Information Administration Docket No. 1540414365-5465-01, RIN 0660-XC019 (filed Jun. 10, 2015).

⁷ See Jonathan Gitlin, *Self-driving Factors and Data Science: We Visit a Modern Farm*, ARSTECHNICA (Jun. 18, 2016, 12:00 PM EDT), <http://arstechnica.com/cars/2016/06/self-driving-tractors-and-data-science-ars-visits-a-modern-farm/>.

⁸ See, e.g., John F. Reid, *The Impact of Mechanization on Agriculture*, 41 THE BRIDGE, Fall 2011, at 14. ("A modern, high-end agricultural machine system is effectively a mobile, geospatial data-collection platform with the capacity to receive, use, sense, store, and transmit data as an integral part of its operational performance.")

billion to the U.S. gross domestic product (GDP) in 2014, a 4.8-percent share.⁹ The agricultural economy extends to a wide range of other sectors that contribute added value to the economy. In 2014, 17.3 million full- and part-time jobs were related to agriculture -- about 9.3 percent of total U.S. employment.¹⁰ Direct on-farm employment provided over 2.6 million of these jobs.¹¹ Employment in related industries supported another 14.7 million jobs.¹² The future of this sector is now intricately linked to the continuing viability of advanced GPS-technologies, and data gathering and sharing through broadband.

With that interest in mind, for more than five years, Deere has worked extensively with the Commission¹³ and other agencies¹⁴ to advance a greater understanding among policymakers, and a more comprehensive technical record in relevant proceedings of the serious interference threat that new high power terrestrial services in nearby spectrum present to many classes of GPS receivers and important GPS end users. Deere remains committed to working with the Commission, the Department of Transportation, Ligado and other stakeholders to evaluate future proposals and solutions for supplemental terrestrial services in the L-band and elsewhere.

II. DEERE POSITION ON LIGADO'S MODIFICATION

Deere herein confirms that it does not oppose grant of the Modification Application, as proposed, that would incorporate the full set of technical parameters and licensing conditions,

⁹ See *Ag and Food Sectors and the Economy*, U.S. DEPT. OF AGRICULTURE ECONOMIC RESEARCH SERVICE, available at <http://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy>.

¹⁰ See *id.*

¹¹ See *id.*

¹² See *id.*

¹³ Deere participated extensively in the Technical Working Group ("TWG") jointly chaired by LightSquared and the USGIC evaluating the interference impact of LightSquared's original MSS L-band terrestrial network proposal, and served as the chair of the sub-group evaluating interference from terrestrial base stations and handsets into high-precision and augmented GPS receivers.

¹⁴ This data and analyses from the TWG effort and other complementary test programs, including extensive testing by government agencies, ultimately led the Commission to determine in January 2012 that Ligado's then-current network proposal presented an immitigable and unacceptable interference threat to GPS.

including specified power limits, out-of-band emissions (“OOBE”) limits, and the determination that the 1545-1555 MHz band may not be used for terrestrial operations,¹⁵ consistent with Deere’s Settlement Agreement with Ligado. Deere’s position is also contingent on the condition that any reissued license will also expressly provide that the protective technical parameters that Ligado has agreed to in the context of its agreement with Deere will apply as a continuing condition to any assignee or transferee of Ligado’s L-band licenses.

Like any litigation settlement, the Settlement Agreement between Deere and Ligado is intended to resolve a particular matter relevant to specific circumstances of individual parties. As such, the terms of the Settlement Agreement reflect each party’s assessment of the right balance and outcome under the circumstances and were not intended to be -- *nor could they be* -- a resolution of all technical and public policy issues that may be raised by Ligado’s Modification Application. Further, Deere’s position on the Modification Application should not be read as an affirmative endorsement of Ligado’s network proposal, because it is not. With respect to interference to Deere’s GPS-enabled equipment, the Settlement Agreement reflects Deere’s judgment only that, notwithstanding interference to existing Deere receivers, it will be able to address interference issues in its technology plan for future Deere receivers assuming the Ligado network complies with the technical and other terms set forth in the Settlement Agreement. Deere cautions against characterizations of the Settlement Agreement that depart from those facts.¹⁶

¹⁵ See New LightSquared LLC Ex Parte, IB Docket Nos. 11-109, 12-340, 1-2 (filed Dec. 31, 2015).

¹⁶ For example, Ligado states that the “the collective result of the negotiations constitutes a comprehensive solution for the entire GPS industry.” Comments of Ligado Networks LLC at 13, IB Docket No. 11-109 (filed May 23, 2016). As discussed above, for clarity, Deere does not share the view that the Deere Settlement Agreement constitutes evidence that all outstanding GPS interference issues have been resolved for all GPS devices in all applications or that Deere affirmatively supports the Ligado proposal. Similarly, Deere disagrees with Viasat’s statements that “major GPS manufacturers support Ligado’s proposal and agree that its adoption would protect commercial GPS devices.” Comments of ViaSat, Inc. at 3, IB Docket Nos. 11-109,

Deere's position should also not be viewed corroborating Ligado's representation that its modified proposal resolves *all* GPS interference (for all devices in all applications). Deere is not providing information on whether and to what extent Ligado's current proposal threatens harmful interference to the broad array of existing and future GPS-enabled devices and applications, other than to Deere's equipment. Deere notes that multiple parties urged the Commission to ensure that protection of GPS and GNSS remains a top priority¹⁷ and others advised the Commission that they continue to have interference concerns regarding Ligado's network even as modified.¹⁸ Some parties encouraged the Commission to look to the ongoing Department of Transportation Adjacent Band Compatibility ("ABC") study and defer action on

12-340; IBFS File Nos. SATMOD-20151231-00090, SAT-MOD-20151231-00091, SAT-MOD-20151231-00981 (filed May 23, 2016). Contrary to ViaSat's suggestion, the Deere litigation Settlement Agreement should not be interpreted as proof that any device beyond Deere's future devices can coexist under the modified network

¹⁷ Greenwood argues that the Commission's first priority should be unconditional protection of GPS and GNSS and urges the FCC to convene a multi-stakeholder forum to conduct and finalize detailed L band compatibility analysis and solutions. *See* Comments of Greenwood Telecommunications Consultants LLC, IB Docket Nos. 11-109, 12-340 (filed May 23, 2016).

¹⁸ *See, e.g.*, NovAtel Inc. Ex Parte Presentation at 4, IB Docket Nos. 11-109, 12-340, IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231-00091, SES-MOD-20151231-00981 (filed May 19, 2016) ("NovAtel Comment") ("[C]oncerns with respect to potential harmful interference to GPS receivers have not yet been addressed by Ligado and represent a legitimate and ongoing concern should Ligado operate a terrestrial mobile network in the referenced MSS L-band frequencies."); Comments of Iridium Communications Inc. at 3, IB Docket Nos. 11-109, 12-340, IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231-00091, SES-MOD-20151231-00981 (filed May 23, 2016) ("[G]rant of the current unaltered Modification Applications -- based on Ligado's proposed operational parameters -- would result in significant harmful interference to Iridium's current and future MSS network."); Letter from Orion Monitoring Systems, Inc. to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109, 12-340 (filed June 6, 2016) ("Orion Comments") (supporting Novatel's position and urging further analysis of Ligado's plan); Letter from The Air Line Pilot Association at 1, International to Marlene H. Dortch, Secretary, FCC, IB Docket No. 11-109 (filed May 26, 2016) ("[E]ven with Ligado's proposed dBW limits, it appears that there is a strong probability for certified aviation GPS devices to experience interference at the proposed power limits."); Comments of the Joint Aviation Parties at 2, IB Docket Nos. 11-109, 12-340, IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231-00091, SES-MOD-20151231-00981 (filed May 23, 2016) ("Joint Aviation Parties Comment") ("Substantial safety of flight concerns remain within the organizations comprising the Joint Aviation Parties regarding the adequacy of the conditions to protect the GPS receivers and other avionics used by the aviation sector, including but not limited to certified aviation receivers, other GPS devices, and satellite communications.").

the Ligado application until that comprehensive process is complete.¹⁹ Further, other parties expressed concern that the Commission must consider the potential impact on other non-domestic GNSS.²⁰ The technical and public interest assessment raised by these comments are outside the scope of Deere's Settlement Agreement and this Reply.

Finally, Deere cautions that its determination not to object to Ligado's Modification Application must not be interpreted as Deere's acquiescence in or, in any way agreement with, Ligado's continued assertions regarding the correct *metrics* for determining potential harm to GPS and other GNSS systems. Indeed, as discussed below, Deere strongly supports the continued [1 dB] threshold and the ABC testing process underway at the Department of Transportation.

III. A ONE (1) dB DECREASE IN CARRIER-TO-NOISE DENSITY REMAINS THE ONLY EMPIRICAL, UNIVERSAL AND QUANTIFIABLE METRIC FOR CONFIRMING HARMFUL INTERFERENCE TO GPS/GNSS SERVICE

Deere reaffirms its staunch support for application of a one (1) dB decrease in Carrier-to-Noise Power Density ("C/N₀") as the appropriate metric for determining whether a GPS receiver has experienced harmful interference. Deere has previously voiced support for this metric, explaining that there is an undeniable correlation between a 1 dB decrease in C/N₀ and harmful interference, including with respect to high-precision receivers a complete failure of the device

¹⁹ See, e.g., Comments of the Resilient Navigation and Timing Foundation, IB Docket No. 11-109 (filed May 24, 2016) ("urging the FCC to hold Ligado's proposal "in abeyance pending the outcome" of studies such as the Department of Transportation's Adjacent Band Compatibility Study.).

²⁰ See, e.g., Comments of Trimble Navigation Limited at 19, IB Docket Nos. 11-109, 12-340; IBFS File Nos. SAT-MOD-20120928-00160, SAT-MOD-20120928-00161, SAT-MOD-20101118-00239, SES-MOD-20121001-0087 (filed May 23, 2016) ("Trimble Comments") (urging the Commission to "expressly recognize the need for the FCC to provide interference protection to devices utilizing spectrum allocated internationally for GNSS which is outside of the 1560-1591 MHz U.S. allocation, including spectrum utilized by other GNSS systems – such as the Global Orbiting Navigation Satellite System ("GLONASS"), Galileo, and BeiDou."); Comments of the Aerospace Industries Association at 2, IB Docket Nos. 12-340, 11-109 (filed May 23, 2016) ("Understanding potential interference to all GNSS services, such as Galileo, GLONASS, and Beidou used by aircraft is also an issue potentially impacting the safety of air travel and should be studied."); Orion Comments at 1 ("The further lack of analysis of the Ligado system's effects on other GNSS constellations such as GLONASS, Beidou and Galileo also causes concern.")

under test.²¹ Deere welcomes the overwhelming support reflected in the instant record for the standard.

No empirical, universal and quantifiable alternative to the 1 dB C/N₀ standard exists for evaluating harmful interference into a GPS/GNSS service. In particular, Deere urges the Commission to avoid the obvious pitfalls and shortcomings of attempting to evaluate interference into GPS/GNSS service based on end user outputs or metrics (*e.g.*, location accuracy), which are inherently subjective and unreliable in this context. Given the tremendous diversity in GPS/GNSS receiver design and use models, even the broadest, most inclusive test program cannot credibly claim to have harmonized and evaluated end user outputs in a meaningful way against a potentially interfering signal. For example, with respect to location accuracy, a degradation of only a few centimeters may render a high-precision receiver unusable or inoperable, whereas a markedly greater degradation may not impact the end user of a general navigation and location device. Even within a discrete class or sub-class of device (*e.g.*, high-precision receivers) there may be varied expectations for location accuracy depending on the end user's application. Moreover, location accuracy for some devices may involve only horizontal position, while other devices may place an emphasis on high accuracy in degraded reception scenarios. Employment of differential correction systems to augment the GNSS signals further complicates the use of position accuracy as a degradation metric.

Due to this diversity in design and use models, any attempt to evaluate location accuracy would need to examine a virtually inexhaustible number of test scenarios to determine if harmful interference occurred from a proposed new terrestrial service, where location accuracy is only one of several important end user outputs. Among other attributes, integrity, continuity and

²¹ Reply Comments of Deere & Company at 8, IB Docket No. 11-109, IBFS File No. SAT-MOD-20101118-00239 (filed Aug. 15, 2011).

availability are also critical and must be evaluated, and the criticality level of these attributes varies widely depending on the class of device and end user application. Ultimately, Deere views any effort to evaluate harmful interference into GPS/GNSS service based on end user outputs as unlikely to survive rigorous scientific scrutiny. Of course, with overwhelming consensus support for the scientifically unassailable 1 dB C/N₀ standard, which can be directly correlated to a degradation in real-world performance of GPS/GNSS devices under test, the Commission need not and should not look for an alternative interference threshold.

A. The Record in Response to the Public Notice Reflects Overwhelming Support for the One (1) dB Interference Threshold

The Public Notice sought specific comment on the “performance or functioning” of GPS/GNSS receivers under test, including metrics for how to determine harmful interference.²² GPS/GNSS-related interests, both prominent GPS device manufacturers and end users, responded to this inquiry with unified and unwavering support for the 1 dB C/N₀ standard. For example:

- The Joint Aviation Parties, an ad hoc coalition consisting of over a dozen parties, including Rockwell Collins, Delta Airlines, SouthWest Airlines and United Parcel Service, stated their support for the “accepted, objective standard of a 1 dB rise in the noise floor” as the interference threshold for GPS, and warned that “attempting to use an accuracy test or other subjective performance metric to assess an interference criterion is impractical and virtually impossible given the multiple ways in which standard GPS devices are used and the many types of devices affected.”²³ The Joint Aviation Parties elaborated that the 1 dB C/N₀ standard is widely employed to evaluate harmful interference into flight and air traffic management systems (including GPS) by regulatory bodies such as the International Telecommunications Union - Radiocommunications Sector and the International Air Transport Association.²⁴ Further, the Joint Aviation Parties clarified that future developments in GPS technology

²² Public Notice at 8.

²³ Joint Aviation Parties Comment at 15.

²⁴ *Id.* at 16-17.

require “known available margin” in space-to-earth signals, which the 1 dB C/N₀ standard provides but other subjective measurements do not.²⁵

- Airlines for America, a coalition consisting of prominent air carriers, including American Airlines, FedEx Corporation and United Airlines, reaffirmed that the “1 dB metric for the GPS interference criterion is the most appropriate metric and should be employed.”²⁶
- GPS manufacturer NovAtel Inc.’s comments reinforce that a direct correlation between a 1 dB degradation in C/N₀ and receiver performance exists, and reaffirms that 1 dB C/N₀ standard is the appropriate threshold for harmful interference given the modest power of the L1 GPS signal on the ground, GPS end user performance demands, and the variability in GPS receiver design and applications.²⁷
- Prominent high-precision GPS manufacturers and integrators AGCO Corporation, Veripos (US) Inc., Phoenix Aerial Systems, Inc. and Leica Geosystems all provided support for the 1 dB C/N₀ standard, explaining that the GPS L1 signal is faint by the time it reaches the ground and vulnerable to interference that creates one (1) dB or less of loss in clean signal to noise ratio.²⁸
- Finally, GPS manufacturers, Garmin International, Inc. and Trimble Navigation, both provided their continued support for the 1 dB C/N₀ standard, with Garmin explaining that “[w]ithout application of a 1 dB decrease in C/N₀ standard, it would not be possible to evaluate and define whether ‘material degradation’ across a wide range of application had actually occurred - not to mention what constitutes ‘material.’ Further without use of such an objective, and universal metric, individual and unique test scenarios would need to be developed for every use case and application.”²⁹

While Deere finds the strong support for the 1 dB C/N₀ standard in response to the Public Notice persuasive by itself, the lack of any meaningful, cohesive alternative proposal for determining harmful interference into GPS/GNSS service is equally if not more compelling. No alternative

²⁵ *Id.* at 18.

²⁶ Comments of Airlines for America at 2, IB Docket Nos. 11-109, 12-340 (filed May 23, 2016).

²⁷ NovAtel Comments at 2.

²⁸ *See* Letter from AGCO Corporation to the FCC, IB Docket Nos. 11-109, 12-340 (filed Jun. 6, 2016); Letter from Leica Geosystems, Inc. to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109, 12-340; SAT-MOD-20151231-00090; SAT-MOD-20151231-00091; SES-MOD-20151231-00981 (filed May 27, 2016); Letter from Phoenix Aerial Systems, Inc. to the FCC, IB Docket Nos. 11-109, 12-340 (filed May 26, 2016); Letter from Veripos (US) Inc. to the FCC, IB Docket Nos. 11-109, 12-340 (filed Jun. 2, 2016).

²⁹ Comments of Garmin International, Inc. at 18, IB Docket Nos. 11-109, 12-340, IBFS File Nos. SAT-MOD-20120928-00160, SAT-MOD-20120928-00161, SES-MOD-20121001-00872, SATMOD-20151231-00090, SAT-MOD-20151231-00091, SAT-MOD-20151231-00981 (filed May. 23, 2016); *see also* Trimble Comments.

exists, however, because as discussed above it is impractical and likely impossible to craft a universal, quantifiable and scientifically sound interference threshold around end user outputs that vary widely not just between classes of GPS/GNSS receiver, but in many instances between individual devices themselves within a class or sub-class.

B. Roberson and Associates Wrongly Asserts that No Correlation Exists between a 1 dB Decrease in Carrier-to-Noise Power Density and Harmful Interference

A report prepared by Roberson and Associates, LLC (“RAA”) and filed in the instant record on June 10, 2016 concludes that testing undertaken by RAA to evaluate the susceptibility of GPS receivers to certain adjacent band signals “found no meaningful correlation between 1 dB change in C/N_0 and GPS device’s (Key Performance Indicator) performance.”³⁰ Deere respectfully disagrees with this conclusion.

While the test report from RAA itself is conclusory and provides inadequate data for Deere to assess how devices under test reacted to a 1 dB decrease in C/N_0 , prior test efforts have already confirmed the correlation between such a decrease and harmful interference. Most significantly, the Technical Working Group (“TWG”) test effort mandated by the FCC and co-chaired by Ligado Network’s predecessor LightSquared and the U.S. GPS Industry Council found a direct correlation between a 1 dB decrease in C/N_0 and loss of real-world performance in devices under test. For example, 90% of high precision receivers under test lost 1 dB of sensitivity when a simulated interfering LTE signal reached -25 dBm; however, 50% of the same receiver class completely lost the ability to track GPS satellites when the interfering signal was markedly lower, at a signal strength of only -28 dBm, and 10% of the same receiver class

³⁰ William Alberth et al., *Final Report: GPS and Adjacent Band Co-Existence Study*, ROBERSON AND ASSOCIATES, LLC (Jun. 10, 2016) at 17 (“RAA Report”). The RAA report is on file with the Commission. See Ligado Networks Ex Parte Presentation Enclosure, IB Docket Nos. 11-109, 12-340; SAT-MOD-20151231-00090; SAT-MOD-20151231-00091; SES-MOD-20151231-00981 (filed Jun. 10, 2016).

completely lost the ability to track GPS satellites when the interfering signal was much lower, at a signal strength of only -54 dBm.³¹ The aviation and general location and navigation sub-teams undertaking TWG testing also confirmed a correlation.³²

Respectfully submitted

/s/ Catherine Wang

Catherine Wang

Tim Bransford

Morgan, Lewis & Bockius LLP

2020 K Street, N.W.

Washington, DC 20006

Tel. (202) 373-6000

Fax (202) 373-6001

Attorneys for Deere & Company

Steve Wilson
Director, Advanced Engineering

Mark Rentz
Senior Systems Engineer

Mark Lewellen
Spectrum Policy Manager

Deere & Company
One John Deere Place
Moline, IL 61265

Dated: June 21, 2016

³¹ See Technical Working Group Final Report, SAT-MOD-20101118-00239, Appendix H.1.11 Figures 84 and 85 (dated June 30, 2011) (“TWG Final Report”).

³² The aviation sub-team explained that “receivers tested failed to meet key performance requirements (WAAS message-loss-rate) in the presence of () signals that resulted in 1 dB degradation of C/N0.” TWG Final Report at 50. Similarly, the general navigation and location sub-team found that with 1 dB C/N0 of degradation 20 out of the 29 devices tested would suffer harmful interference from a proposed LTE waveform in adjacent spectrum to the L1 signal. *Id.* at 177.